N^+ are repelled. The growth process is carried out as described above with addition of an acceptor source **24** so that Ga, nitrogen and acceptor are deposited on the electron-rich surface of the substrate. As the acceptor atom approaches the surface, it takes on an electron and is incorporated into the lattice as a negative species, the energy of incorporation being lower than that of the neutral acceptor species. The same procedure is used to dope the GaN lattice with donor impurities, except that a negative bias is used on the substrate or the grid. Alternately, a charged surface can be generated by bombarding the substrate with electrons or positive ions. Electron guns and ion guns, respectively, are conventional sources of these species.

Suitable acceptor species include, but are not limited to, zinc, magnesium, beryllium, and calcium. Suitable donor species include, but are not limited to, silicon, germanium, oxygen, selenium and sulfur.

What is claimed is:

1. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of(100) Silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer having a thickness of about 30 Å to about 500 Å, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride; and

a first growth layer grown on the buffer layer, the first growth layer comprising gallium nitride and a first dopant material.

2. The semiconductor device of claim **1** further comprising:

a second growth layer grown on the first growth layer, the second growth layer comprising gallium nitride and a second dopant material.

3. The semiconductor device of claim **1** wherein the buffer layer is grown at a first temperature and wherein the first growth layer is grown at a second temperature higher than the first temperature.

4. The semiconductor device of claim **3** wherein the first temperature is in the range of about 100° C. to about 400° C.

5. The semiconductor device of claim **3** wherein the second temperature is in the range of about 600° C. to about 900° C.

6. The semiconductor device of claim **1** wherein the buffer layer is grown by exposing the substrate to gallium and nitrogen at the first temperature for about 3 to about 15 minutes.

7. The semiconductor device of claim **1** wherein the first dopant material is a donor.

8. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of(100) silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide. (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride;

a first growth layer grown on the buffer layer, the first growth layer comprising gallium nitride and an acceptor dopant material;

a second growth layer grown on the first growth layer, the second growth layer comprising gallium nitride and a donor dopant material.

9. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a fast material grown on said substrate, the first material consisting essentially of gallium nitride;

a first growth layer grown on the buffer layer, the first growth layer comprising gallium nitride and a first dopant material;

a second growth layer grown on the first growth layer, the second growth layer comprising gallium nitride and a second dopant material; and

wherein the first growth layer comprises a first conductivity type and the second growth layer comprises the opposite conductivity type.

10. The semiconductor device of claim **9** wherein the first conductivity type is n-type.

11. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of(100) silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride;

a first growth layer grown on the buffer layer, the first growth layer comprising gallium nitride and a first dopant material;

wherein the buffer layer is a recrystallized , partially amorphous layer.

12. The semiconductor device of claim **3** wherein the buffer layer is a recrystallized, partially amorphous layer.

13. A semiconductor device comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer, comprising a first material grown on said substrate, the first material comprising gallium nitride; and

a near intrinsic gallium nitride layer grown on the buffer layer and having a resistivity of greater than 10^8 Ω·cm. at room temperature.

14. The semiconductor device of claim **13**, wherein the near intrinsic gallium nitride layer has a resistivity in the range of about 10^8 Ω·cm to about 10^{12} Ω·cm at room temperature.

15. A semiconductor device having an activated p-type layer comprising:

a substrate, said substrate consisting of a material selected from the group consisting of (100) silicon, (111) silicon, (0001) sapphire, (11–20) sapphire, (1–102) sapphire, (111) gallium aresenide, (100) gallium aresenide, magnesium oxide, zinc oxide and silicon carbide;

a non-single crystalline buffer layer having a thickness of about 30 Å to about 500 Å comprising a first material grown on said substrate, the first material consisting essentially of gallium nitride; and